Optical Design for See-Through Near-Eye Display using Dihedral Corner Reflector Array

Kazuki Otao

For augmented reality with an immersive experience, an optical see-through head-mounted display (OST-HMD) with a wide viewing angle is desired. Although various methods for realizing OST-HMD have been proposed, expansion of the viewing angle remains a challenge. We propose a novel OST-HMD realizing wide viewing angle using a dihedral corner reflector array (DCRA). DCRA is a transmissive optical element that forms a real image of an input light source at a plane symmetrical position. Conventionally DCRA has been used for the aerial imaging system, nevertheless, we introduce DCRA as an optical element for the near-eye display. We employ DCRA to create an aerial lens in front of the eyeball which does not exist physically. In the proposed method, a wide viewing angle is possible because the optical path length between the aerial lens and the eyeball is shortened.

We implemented two prototypes called “Air Mounted Eyepiece” which is a combination of simple lens and DCRA, and “Light Field Blender” which is a combination of a light-field display and DCRA. In this thesis, we describe the detailed on the structure and properties of DCRA, the simulation result of optical performance, the design method for two prototypes, the implementation of the optical system and rendering software, and the result of display quality in both prototypes.

(Advisor: Yoichi Ochiai)